CARNIVOROUS PLANT NEWSLETTER

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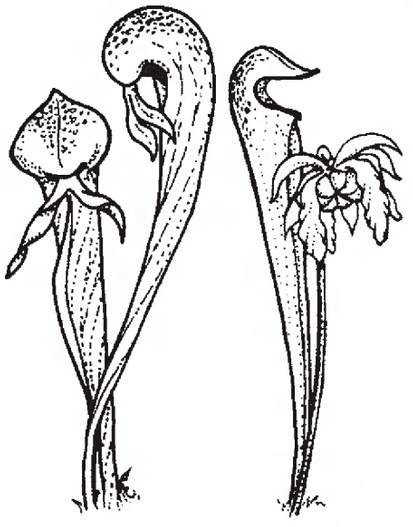

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Journal of the International Carnivorous Plant Society
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Front Cover: *Pinguicula planifolia* under several centimeters of water in Liberty County, Florida. A crayfish has decided its leaves make for good cover. Photo by Barry Rice. Article on page 117.

Back Cover: *Pinguicula australandina* growing in the Cerro Catedral, Argentina. Photo by Danel Josu Aranoa. Article on page 101.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Advertisers should contact the editors. Views expressed in this publication are those of the authors, not the editorial staff.

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Farewell to Adrian Slack

In early June of this year, many of us on the Internet received the sad news that Adrian Slack had died on 3 June 2018.

Adrian Slack was a famed British horticulturist that played a crucial role in the popularization of carnivorous plants, especially in horticulture. He wrote the influential book, "Carnivorous Plants" (1979) that was, for years, the closest we carnivorous plant horticulturists had to scripture—it was the best source of cultivation information we had. I studied every word of that book, as I reread it countless times. Then, in 1986, he followed that book with "Insect-Eating Plants and How to Grow Them"—which became another classic.

I cannot emphasize enough how important Slack's books were to us, in the pre-internet era. This was a time when it was easy to own just about every carnivorous plant book that had ever been published. And while most were suitable for being read once, Slack's books were timeless and seemingly inexhaustible. Not only were they content-rich, but as you read them, you could imagine being in the greenhouse with Slack. He dreamed of a day in which carnivorous plants were commonplace in gardens and hoped that *Pinguicula* and *Sarracenia* could be bred with that target in mind. He was an early explorer of horticulture for these plants, most of which were poorly known. He developed the first suite of interesting cultivars, many of which are highly sought even today.

Thank you, Mr. Slack, for your unequaled contribution to the fascinating realm of carnivorous plant horticulture.

The December 2018 issue of CPN will contain an extensive memorial to Adrian Slack.

Barry Rice, editor

Drosera filiformis, *D. tracyi*, and their hybrids: a photo essay

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Keywords: hybrids, *Drosera filiformis*, *Drosera tracyi*, *Drosera* × *californica*.

The taxonomic relationship of *Drosera filiformis* Raf. and *Drosera tracyi* Macf. has been mired in controversy for over a century (Rice 2011). Part of the reason for the controversy is the plants are similar to each other and quite different from the other North and South American *Drosera* section *Drosera* species (see Fleischmann *et al.* 2018 for species no longer considered to be in section *Drosera*). Another part of the reason is classical taxonomists make decisions based on dead, dried plants. The taxonomically valid differences between *D. filiformis* and *D. tracyi* are subtle. The purpose of this photo essay is to document the similarities, differences, and possibly unexpected behaviors of live plants to inform us on how to consider *D. filiformis*, *D. tracyi*, and their hybrids.

For the past eight years I have been growing and studying what could be called *Drosera filiformis* complex plants in order to better understand their relationships. I grow the plants outside as much as possible in Ashland, Oregon, to attempt to have them all under identical conditions. Growing USA gulf coast plants outside year-round in Ashland can be problematic owing to the elevation and low humidity allowing large daily temperature swings, potential for early and late season freezes, and relatively short growing season. I maintained backup plants in my garage under lights as much as possible. In particular, *D. tracyi* may exhibit no losses outside some winters and greater than 50% others. The plants do not get as large as they would in their natural habitat. I have clones of *Drosera filiformis* var. *floridana* B.Rice (Rice *et al.* 2017) that do not go sufficiently dormant to be outside with below freezing temperatures and one clone of that variety that survives best outside all winter without protection.

The clones used in this study run the gamut from Atlantic coast *D. filiformis* var. *filiformis*, through a series of known and expected hybrids to definite *D. tracyi* as well as *D. filiformis* var. *floridana*. I have not studied *Drosera* × *californica* var. *arenaria* B.Rice (Rice 2017), the hybrid between *D. filiformis* var. *floridana* and *D. tracyi* nor inter-variety hybrid plants of *D. filiformis* although I do have plants I suspect are *D.* × *californica* var. *arenaria* (Fig. 1).

As much as possible I have used plants with good location data. Those plants are listed with the source county and state. However, doing scientific studies with clones that have been in cultivation for 40 years or more is treading on treacherous ground. To better understand the relationship between *D. filiformis* and *D. tracyi* and validate the use of the metrics in Rice (2011) we do have to look at all available material, especially suspect and known hybrids. The plant I have labeled "received as *D. tracyi*" may or may not be the pure species. Under the species description in Rice (2011) it is probably *D. tracyi*, but it is different from the other definite *D. tracyi* clones I have seen. The differences could be part of the natural variation in *D. tracyi* and/or how it responds to my growing conditions. *D.* × *californica* 'California Sunset' is an artificial hybrid between *D. filiformis* var. *filiformis* and *D. tracyi* (Robinson 1981). *D.* × *californica* 'Portland Sunrise' appears to be a complex hybrid that occurred under cultivation and more closely resembles *D. filiformis*. There are two additional hybrids that are commonly available. I received plants I will call *D.* × *californica* "FG" from two different sources but they were different. For this study I used the one from the source who had grown it longest assuming the plants from the other source would be more likely to have been propagated via seed. I also received a clone I will call *D.* × *californica* "CG" from the more reliable source. Both clones are very similar to *D.* 'California Sunset' except they are more compact

Figure 1: Flower of a plant that appears to be from a *Drosera* × *californica* var. *arenaria* hybrid swarm. The plant is smaller and darker red than *Drosera* × *californica* var. *arenaria* as described by Rice (2017) but according to taxonomic rules, backcross hybrid progeny maintain the hybrid name. It was a seed-grown plant from a selection of large supposed *D. filiformis* var. *floridana* from Washington County, Florida.

plants and can be, but not always, somewhat redder under my conditions. *D.* × *californica* "FG" has slightly different flowers.

Figure 2 is a photo taken in mid-June of five representative clones grown outside. *Drosera filiformis* var. *floridana* "white flower" is consistently that red. It does not get as tall as the other *Drosera filiformis* var. *floridana* clones I have and is winter hardy in Ashland. The *D. filiformis* var. *filiformis*, Columbus County, North Carolina, plants tend to be larger and paler than the New Jersey plants. The *D. tracyi* plants in the photo are not quite blooming size.

Closeup images of leaves of the clones used in this study are shown in Figures 3 & 4. The photos are at the same scale. The leaves of what I consider canonical *D. tracyi* tend to be wider and to be more densely covered with shorter tentacles than are the leaves of *Drosera filiformis* and the hybrids. The tentacle heads are clear to pale red. The *D. tracyi*, Hanrahan Ranch plant has very pale tentacle heads. The Hanrahan Ranch, a 20-acre private CP reserve in Baldwin County, Alabama (Miller 2013), has a mix of *D. tracyi* with nearly clear to pale red tentacle heads plus anthocyanin-

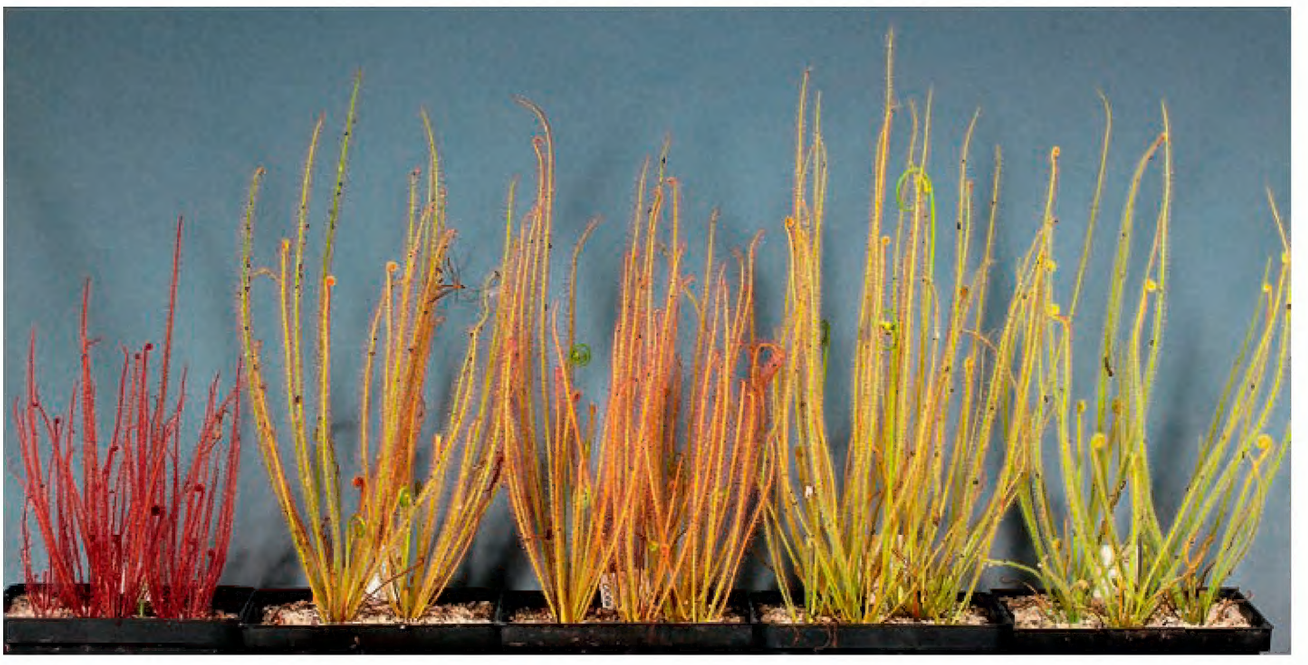

Figure 2: *Drosera filiformis* complex plants. Left to right: *D. filiformis* var. *floridana* "white flower", Washington County, FL; *D. filiformis* var. *filiformis*, Columbus County, NC; *D. filiformis* var. *filiformis*, Ocean County, NJ; *D.* × *californica* 'California Sunset'; *D. tracyi*, Hanrahan Ranch collection.

free (no red pigment) plants and occasional hybrids with *D.* 'California Sunset'. The *D. tracyi* "unknown source" plant can put out *D. filiformis*-like leaves in the spring and young leaves can have dark red tentacle heads. I have observed similar *D. filiformis*-like leaves on herbarium specimens of *D. tracyi* so do not know what to think of the plant. In the hybrids except for *D.* × *californica* 'Portland Sunrise', the tentacle heads become paler as the leaves age. Similar aged leaves of *D. filiformis* do not become noticeably paler.

Leaf photo dates and measurements taken from the photos are shown in Table 1. Rice (2011) used an index of tentacle length/leaf width to categorize *D. filiformis* complex plants. The ±1σ values for the tentacle length/leaf width for *D. tracyi* were 0.9-2.3 and for *D. filiformis* (both varieties lumped) were 2.6-4.8. His measurements were taken from herbarium specimens. It appears these numbers need to be adjusted for live specimens although the trends are the same. The advantage of using the ratio in studies is the index has no units, meaning it doesn't matter how you make the measurements. I find it convenient to measure off photos and scans on a computer screen. I measure the typical maximum distance between tips of tentacles across a leaf then use a formula subtracting the width of the leaf lamina and dividing by two to get the tentacle length. The examples in this paper are of selected typical leaves while Rice likely used a larger selection of leaves for each plant giving his data a larger variance.

Closeup images of the flowers of most of the clones used in this study are shown in Figures 5 & 6. The photos are not to scale. As would be expected, the flowers of *D. tracyi* were the largest. The hybrid flowers were generally intermediate between *D. tracyi* and *D. filiformis* var. *filiformis* with larger plants of *D. filiformis* var. *filiformis* from North Carolina having flowers the same size as smaller flowered hybrids. The *D. filiformis* var. *floridana* flowers were the smallest. Note that the styles of *D. tracyi* and most of the hybrids are longer than those of *D. filiformis*. This is a key difference between the species and it results in *D. tracyi* and the similar hybrids having lower rates of self-pollination. What stands out in the photos is the flower petals of *D.* × *californica* "FG" and *D. filiformis* var. *filiformis*, Columbus County, NC, are relatively wider than comparable clones. If

Table 1. Clones of *Drosera filiformis*, *Drosera tracyi*, and their hybrids used in this study. Measurements were made from images calibrated for size.

Image	Clone	Leaf Photo Date yyyymmdd	Max Tentacle Length (mm)	Max Leaf Width (mm)	Tentacle/Leaf Width (mm)
a, A	*D. tracyi*, Hanrahan Ranch collection	20140705	1.9	2.0	1.0
b	*D. tracyi*, Walton County, FL.	20140705	1.8	1.9	0.9
c, B	Received as *D. tracyi*, unknown source	20170725	1.6	1.2	1.3
d	Earlier leaf of (c)	20170704	2.6	0.9	2.8
e, C	*D.* × *californica* 'California Sunset'	20170725	1.7	1.4	1.2
f, D	*D.* × *californica* "CG"	20140705	1.8	1.6	1.1
g	Older leaf of (f)	20140821	1.7	1.4	1.2
h, E	*D.* × *californica* "FG"	20140705	2.2	1.7	1.3
i	Older leaf of (h)	20140821	1.5	1.5	1.0
j, F	*D.* × *californica* 'Portland Sunrise'	20140701	3.0	0.9	3.3
k	Older leaf of (j)	20170727	2.5	1.2	2.1
l, G	*D. filiformis* var. *filiformis*, Columbus County, NC	20140707	2.2	1.4	1.6
m	Older leaf of (i)	20170727	2.8	1.3	2.1
n, H	*D. filiformis* var. *filiformis*, inland Ocean County, NJ	20140703	2.6	1.1	2.3
o, J	*D. filiformis* var. *filiformis*, coastal Ocean County, NJ	20140703	2.3	1.3	1.7
p	Older leaf of (o)	20170727	2.2	1.1	2.0
q, K	*D. filiformis* var. *floridana*, unknown location	20130912	1.8	0.6	2.9
r, L	*D. filiformis* var. *floridana* "white flower", Washington Co., FL	20170616	2.1	0.6	3.4

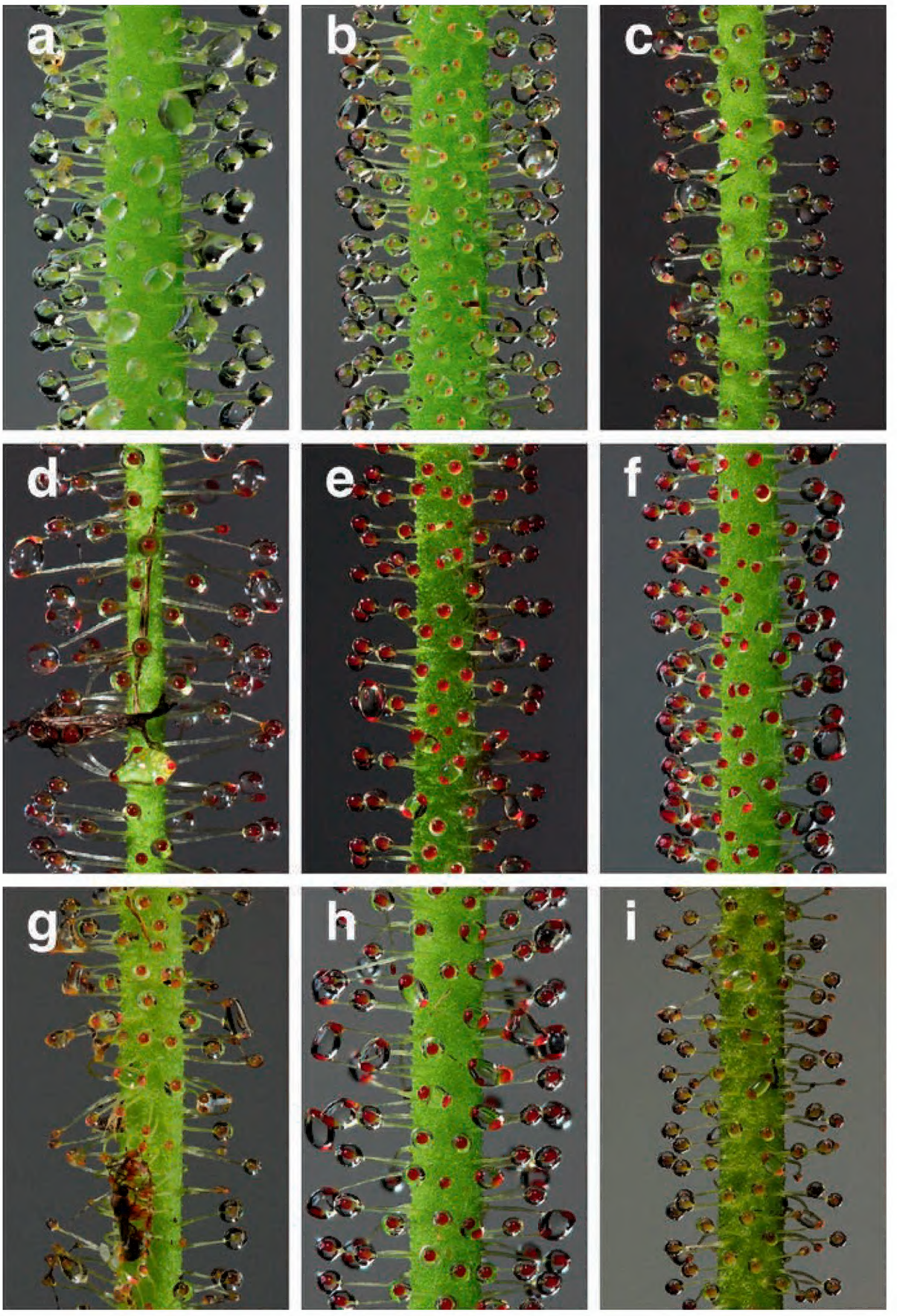

Figure 3: Leaves of *Drosera tracyi* and *D. tracyi* × *filiformis* hybrids. Typical early summer leaf unless otherwise noted. (a) *D. tracyi*, Hanrahan Ranch collection. (b) *D. tracyi*, Walton County, FL. (c) Received as *D. tracyi*, unknown source. (d) Earlier leaf of (c). (e) *D.* × *californica* 'California Sunset'. (f) *D.* × *californica* "CG". (g) Older leaf of (f). (h) *D.* × *californica* "FG". (i) Older leaf of (h). Each image is 7 mm × 10.5 mm.

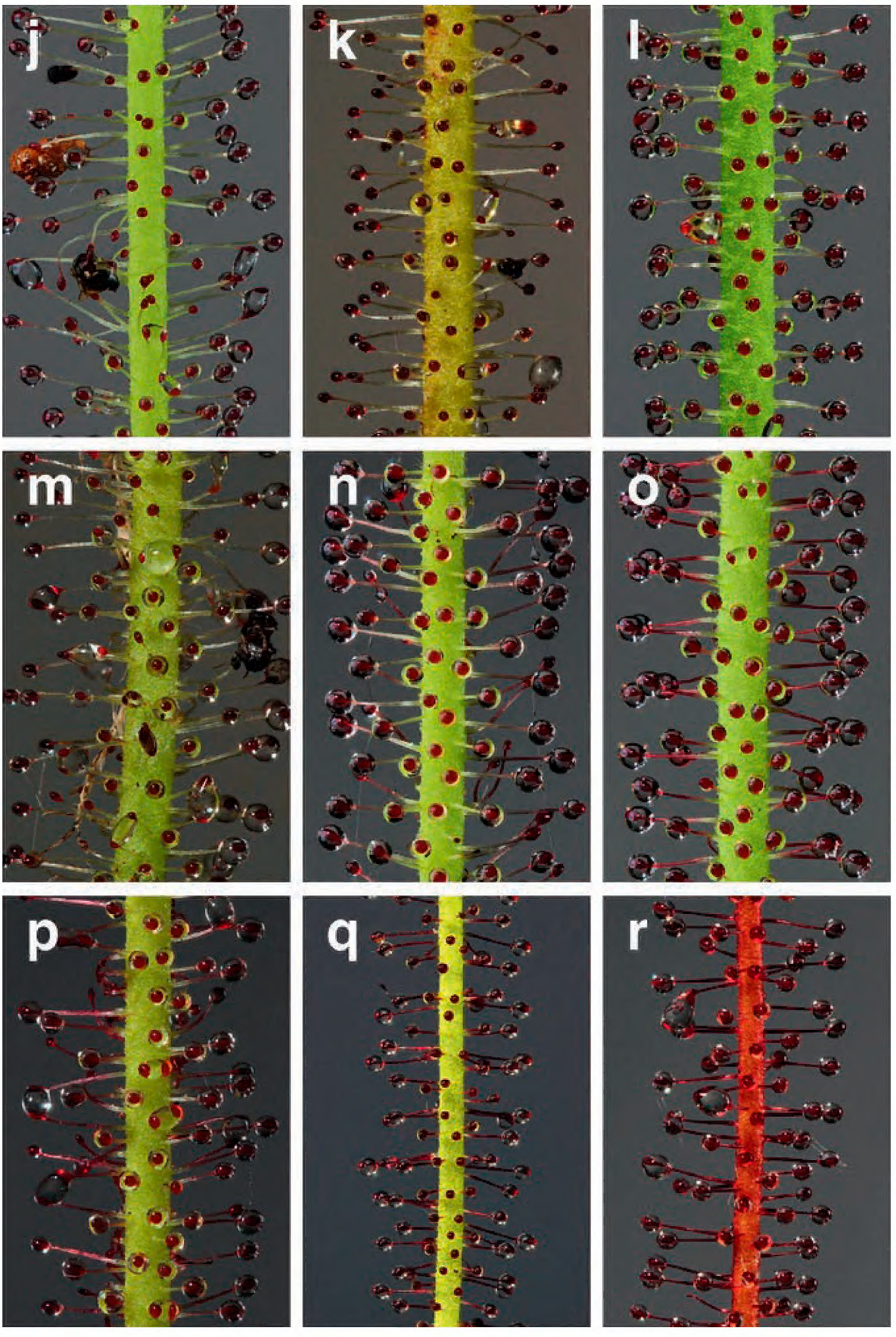

Figure 4: Leaves of *Drosera filiformis* and *D. tracyi* x *filiformis* hybrids. Typical summer leaf unless otherwise noted. (j) *D.* × *californica* 'Portland Sunrise'. (k) Older leaf of (j). (l) *D. filiformis* var. *filiformis*, Columbus County, NC. (m) Older leaf of (i). (n) *D. filiformis* var. *filiformis*, inland Ocean County, NJ. (o) *D. filiformis* var. *filiformis*, coastal Ocean County, NJ. (p) Older leaf of (o). (q) *D. filiformis* var. *floridana*, unknown location. (r) *D. filiformis* var. *floridana* "white flower", Washington County, FL. Each image is 7 mm × 10.5 mm.

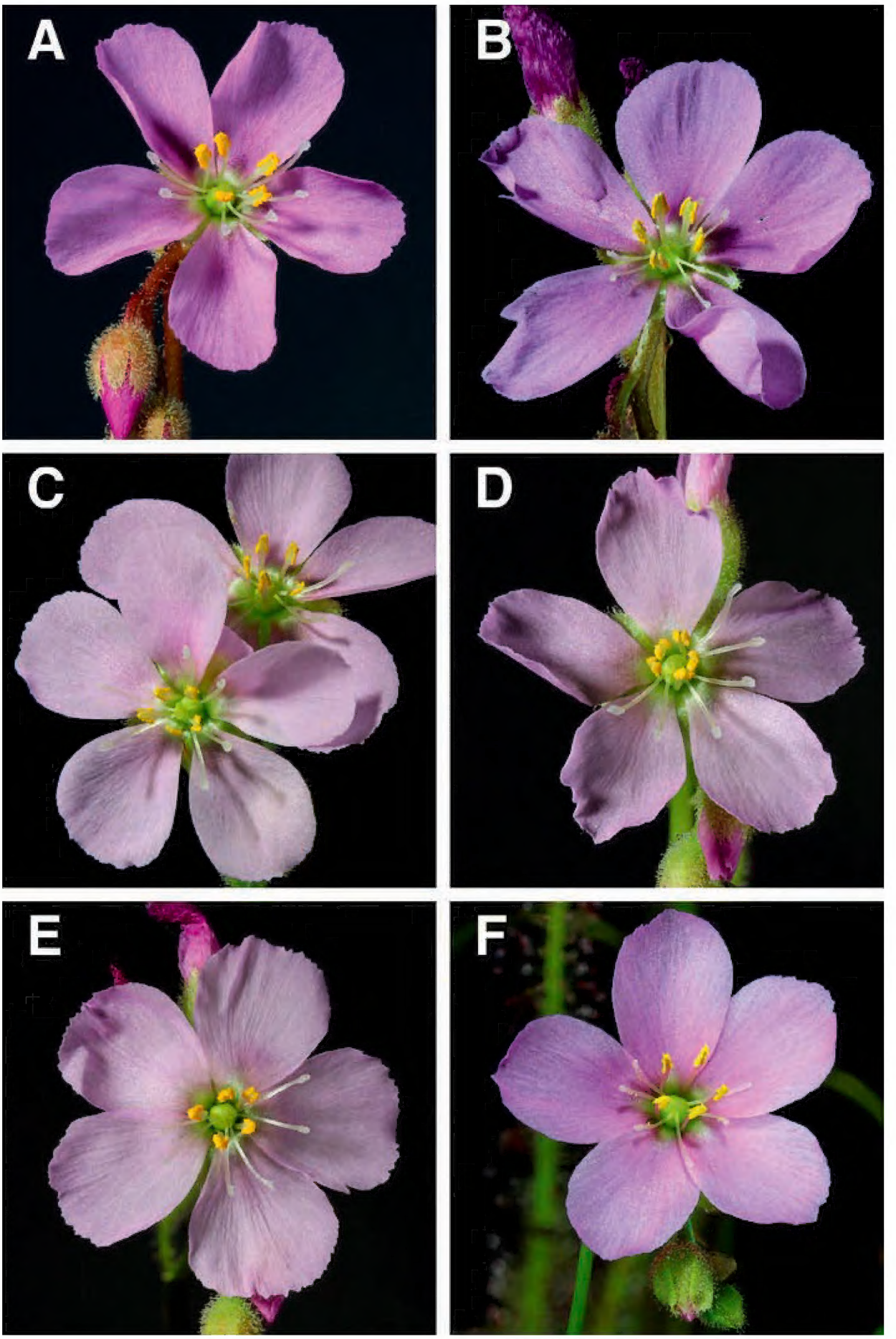

Figure 5: Flowers of *Drosera tracyi* and *D. tracyi* × *filiformis* hybrids. (A) *D. tracyi*, Hanrahan Ranch collection. (B) Received as *D. tracyi*, unknown source. (C) *D.* × *californica* 'California Sunset'. (D) *D.* × *californica* "CG". (E) *D.* × *californica* "FG". (F) *D.* × *californica* 'Portland Sunrise'. Images not to scale.

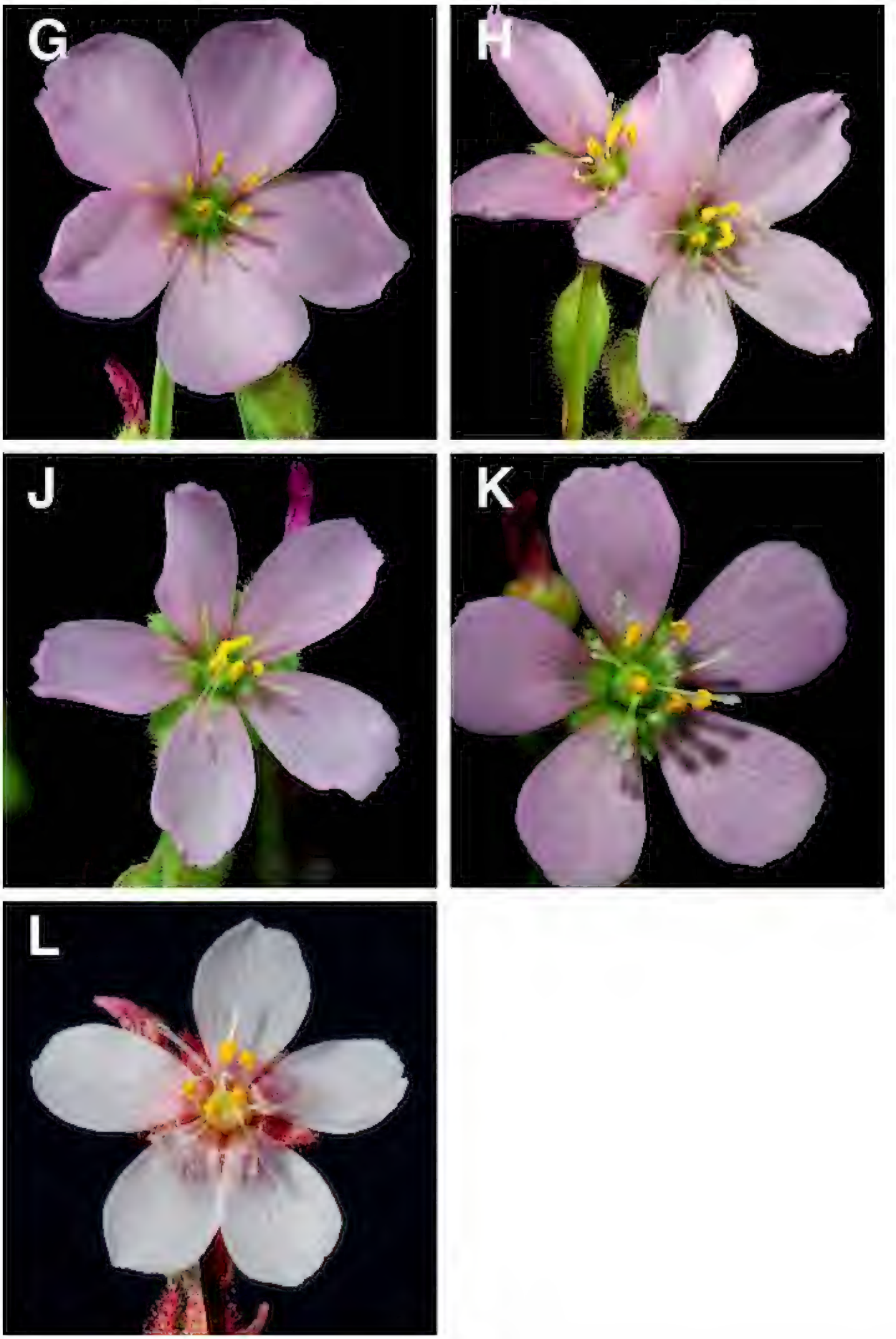

Figure 6: Flowers of *Drosera filiformis*. (G) *D. filiformis* var. *filiformis*, Columbus County, NC. (H) *D. filiformis* var. *filiformis*, inland Ocean County, NJ. (J) *D. filiformis* var. *filiformis*, coastal Ocean County, NJ. (K) *D. filiformis* var. *floridana*, unknown location. (L) *D. filiformis* var. *floridana* "white flower", Washington County, FL. Images not to scale.

anything, I would have expected the "CG" plants to have similar petals to the North Carolina plants if any did. Unfortunately, there are no officially published plant descriptions, photos or source information for the hybrids in question.

My reasons for studying the *Drosera filiformis* complex are I think the plants have an interesting evolutionary story to tell and formal taxonomy is impeding a full understanding of the plants. How we name plants molds how we think about them. *D. filiformis* var. *filiformis* and *D. tracyi* are as good a species as you can get in a group of species that can interbreed and probably do at an extremely low level. I would add *D. filiformis* var. *floridana* to that list being a species as well. Unfortunately, it is a species in danger of going extinct by hybridization with *D. tracyi*. There are very few populations and when they occur near *D. tracyi* they produce hybrids (Rice 2010, 2017; Rice *et al.* 2017).

Acknowledgements: I thank Damon Collingsworth, Djoni Crawford, Peter D'Amato, Jason Ksepka, Kevin Tarner, Harry Tryon, and Mike Wilder for providing plants or seeds, Victor Holland and Mark Todd for giving me a tour of *Drosera filiformis* sites in North Carolina, Djoni Crawford for assistance on the manuscript, and Barry Rice for discussion and comments on the manuscript.

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In search of Andean *Pinguicula*

Danel Josu Aranoa • pasaje La Blanqueada 5249 • B. Ciudad Autónoma de Buenos Aires • Argentina • danelaranoa@gmail.com

During January 2018, my girlfriend and I had the chance to travel on holidays to southern Argentina for two weeks. We were able to plan the journey, paths to take, and places to visit. Of course, setting aside time to search for carnivorous plants was essential. We were counting on the previous experience of local acquaintances, with whom we had already found, allegedly, *Pinguicula chilensis*. After a taxonomic revision, Gluch (2017) showed that the name of *P. chilensis* was invalid due to an incorrect lectotype. Therefore, Gluch chose a new holotype and named it *P. australandina*. In addition, Gluch described a new species from the Nahuelbuta mountain range in Chile that was formerly considered to also be *P. chilensis* and named it *P. nahuelbutensis*. Two *Pinguicula* species are known to occur in Argentina: the well-known *P. antarctica*, and *P. australandina*.

We knew that plants of *P. australandina* (Fig. 1) are found above 1400 m above sea level. Therefore, we planned our ascent of two *cerros* (peaks): Cerro Catedral in San Carlos de Bariloche, where we had already found specimens two years ago helped by friends from the area; and to Cerro Lindo in El Bolson, which we had never climbed before, but of which we had heard about sites of *Pinguicula* reported by the locals.

Figure 1: *Pinguicula australandina*.

Cerro Catedral

Backpacks on our shoulders and water bottles full, we began our ascent to the Frey shelter on the shore of Toncheck Lagoon at some 1600 m a.s.l. We hiked across the *lenga* beech forest (where *Nothofagus pumilio* -Nothofagaceae- and *Chusquea culeou* -Bambusoideae- predominates) until reaching a zone where the arboreal vegetation recedes, and grasses and rocks start to be seen in greater abundance. Climbing through the last large-sized rocks, we managed to see the shelter in the distance. But some 15 minutes before our arrival, we encountered a stream across our path and finally saw our first *Pinguicula*. At approximately a meter away from the water, growing in the substrate deposited between the rocks and its cracks, mostly sheltered from the sun, beneath and in-between the grasses, we found the first colonies spreading across several meters (Fig. 2). We had to look thoroughly as they were no larger than 5 cm in diameter each.

Figure 2: *Pinguicula australandina* on the Cerro Catedral.

Sadly, at the end of January their flowering season was coming to an end and most of the corollas had fallen, and the fruits were young so we had no chance to see any seeds.

After having combed the first area, we crossed the stream and climbed a hundred meters more, and at 1700 m a.s.l., far from any body of water (that we could see at least), we found another colony (Figs. 3 & 4). I had already found this colony in 2016 and I was pleased to see how it had expanded by noting the presence of minuscule seedlings and new specimens in the surroundings, where two years ago there were none.

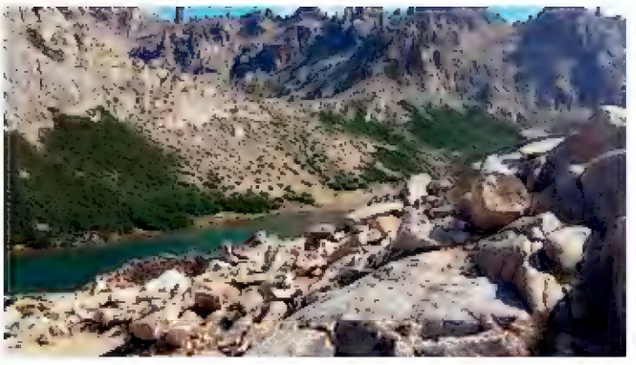

Figure 3: The rocks on the Cerro Catedral at right are where the plants were found at an elevation of 1700 m. Toncheck Lagoon is behind.

Figure 4: The higher elevation population at 1700 m on the Cerro Catedral, far from visible water streams.

Cerro Lindo

Located in the south of the Rio Negro province, in El Bolson, the Cerro Lindo is seldom visited, and its shelter is found at 1500 m a.s.l. We began our ascent crossing the Azul River and a plain to go deep into the Valdivian laurifolian forest (temperate Valdivian forest or Valdivian jungle as the locals call it), hiking without rest until our destination. This forest, where arboreal formations of laurifolias leaves predominate (*Luma apiculata* -Myrtaceae-, *Nothofagus dombeyi* -Nothofagaceae- or *Weinmannia trichosperma* -Cunoniaceae- are some species we observed), is considered a biogeographic island because it is an isolated ecosystem and presents a multitude of endemisms.

Approximately at 1400 m a.s.l., we found a lagoon where we could see sphagnum moss. After hiking a bit longer, the forest opened, revealing a plain crossed by a stream (Fig. 5). And there, we first found some scattered *P. australandina* specimens. After finding no more than a few of them, we resumed our journey to the shelter, where a waterfall flows over a formation of stone and sharp slate just a few meters away. As we climbed these rocks and inspected the surroundings, we found *Pinguicula* in practically every available corner. At this time of year, the substrate was quite moist as it was near the waterfall. The stream and waterfall exists only in summer and comes from melting snow and ice from the summit. During winter the stream and waterfall is frozen.

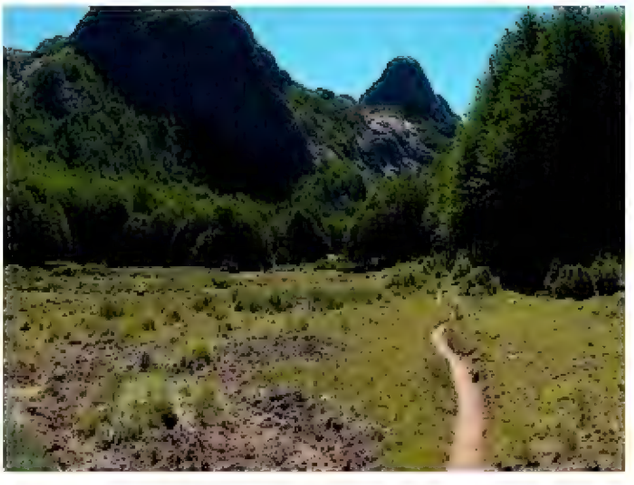

Figure 5: Landscape on Cerro Lindo where we found the first specimens of *Pinguicula australandina* before reaching the shelter.

None of the plants had flowers and we noticed that the coloration of their leaves was more orange or yellowish in comparison to those found in Cerro Catedral, probably because of a higher exposure to sunlight since small succulent-leaved plants predominate in the area where they grow, not grasses.

Going higher up on the opposite side of the waterfall wall at 1600 m a.s.l., a bog spreads from a lagoon, and at its shores there are dense colonies of *Pinguicula australandina*.

Morphological Diversity

Pinguicula australandina is a species that presents a wide range of shapes and colors, both in its leaves and its flower.

In general, the individuals found in the Cerro Lindo have a more yellowish or orange color than those in the Cerro Catedral, possibly because of a greater solar exposure, since they are not protected between grass, but the other variations are common to both locations with apparently same growing conditions.

The flowers have a color variation from soft violet with purple lines, to purple in the petals and yellowish white in the spur (Fig 6). We saw that the spur had different lengths, from almost absent to few millimeters (3-4 mm).

Figure 6: *Pinguicula australandina* flower color varies from soft violet to purple.

Figure 7: Some *Pinguicula australandina* open their leaves more, while others keep them more rolled up.

Some *Pinguicula australandina* open their leaves more (Back Cover), while others keep them more rolled up (Fig. 7). The coloration of the leaves varies with solar exposure, becoming reddish when the plants are more exposed to the sun. On a cultivated specimen with the highest exposure possible, the coloration becomes almost completely red.

Environment, Climate, and Substrate

We found all plants were always above 1400 m a.s.l. in open, well-lit spaces, and in most cases between pastures, partially protected from direct solar exposure. However, some plants were exposed and in perfect condition. The climate is alpine, and because of the latitude and elevation, it's also a glacial and snowfall area, which means that in winter the plants are buried underneath several meters of snow and, occasionally, ice. Perhaps this is the reason why they only grow in cracks and holes, places where air pockets form so the snow doesn't make direct contact with the leaves, avoiding frost damage.

The substrate is composed of dust, gravel, rock particles from wind erosion, and pumice stone, pressed together and permanently moist but not waterlogged.

Researchers: Danel Josu Aranoa, Rocío Belén Arce, Juan Merino, and Ignacio Merino.

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Finding *Drosera condor* on the Peru/Ecuador Border

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In late August 2017, I visited the cities of Cuenca and Loja, in southern Ecuador, for work. I'd planned to spend the Labor Day extended weekend exploring that part of the country for carnivorous plants. My holy grail was the Cordillera del Condor on the Ecuador/Peru border, a series of tepui-like sandstone escarpments extending 150 km along a north-south axis, rising up to 2900 m in altitude (Fig. 1). Geologically and floristically, the Cordillera del Condor is very different from the Andes.

I'd been dreaming of exploring the Cordillera del Condor for over 20 years, ever since the mid 1990's when I saw an herbarium specimen of an odd sundew collected there. It was identified as *Drosera chrysolepis* Taub., but to me it looked more like a yet undescribed taxon from Brazil that at the time I called *D.* sp."stemless chrysolepis", and which I published as *D. camporupestris* Rivadavia in 2003 (Rivadavia 2003). In that article, I wrote:

"An incomplete specimen identified as *D. chrysolepis* collected on the Cordillera Condor in southern Ecuador… is apparently conspecific with *D. camporupestris*. Yet I hesitate to include it under *D. camporupestris* since it was collected over 4000 km from any of the known sites in Brazil. Further and more complete specimens from Ecuador would need to be examined first."

More herbarium specimens from these remote highlands, on both sides of the Ecuador/Peru border, were indeed uncovered over the years and studied in more detail. Eventually I and four co-authors published this plant as *D. condor* Gonella, A.Fleischm. & Rivadavia in 2016 (Gonella *et al.* 2016), a new species more closely related to two other Andean sundews, the equally mysterious *D. cendeensis* Tamayo & Croizat and *D. peruensis* T.Silva & M.D.Correa.

No matter how much I yearned to see live *D. condor in situ*, I was under no illusion that a 3-day trip would be enough to figure out a path to the top of those remote escarpments. My modest goal

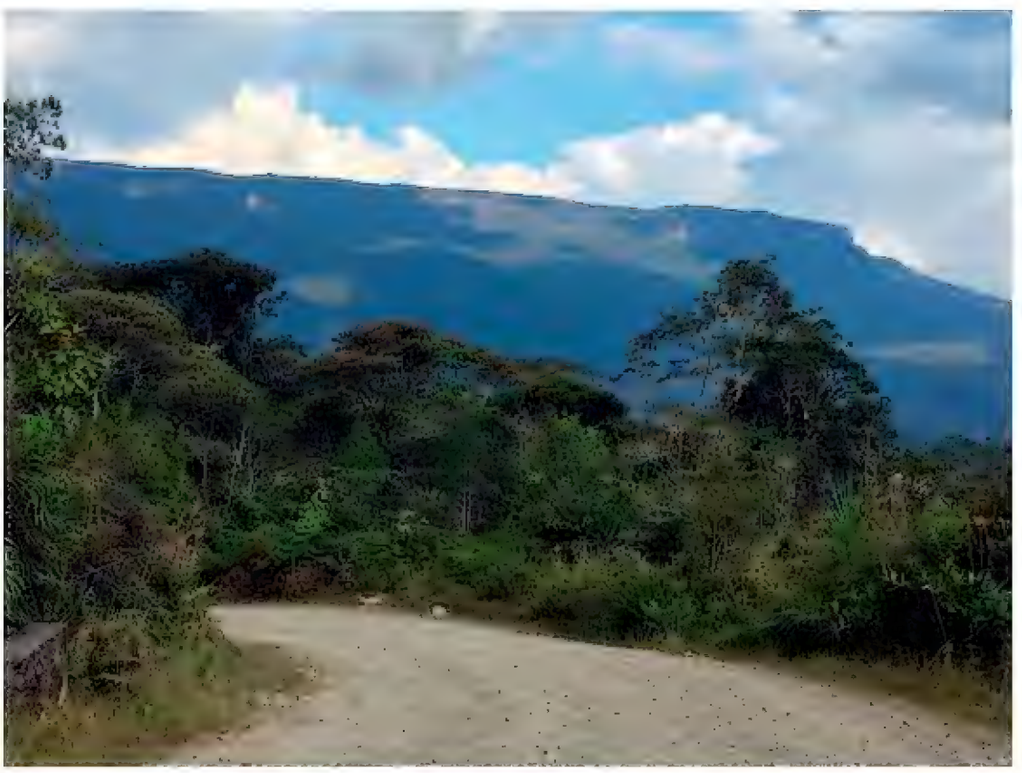

Figure 1: Cordillera del Condor on the Ecuador/Peru border.

for this trip was one of reconnaissance, to scope out the region, talk to locals, gather intel, try to contact potential guides, investigate which of the tepui-like plateaus of the Cordillera del Condor would be more feasible to reach on a future expedition, scope out potential best paths to the top, and maybe even explore some dirt roads with my stick shift 1.0 tiny 2-wheel-drive rental car.

Early on Saturday morning, I left the city of Loja and briefly explored the Podocarpus National Park for epiphytic *Utricularia* (no luck) before driving down the eastern Andean slopes into the steamy Amazonian lowlands. Before doing so, I opened Google Earth on my laptop and began reviewing the numerous markers dotting the Cordillera del Condor, where I'd spent countless hours over the years identifying interesting roads, promising clearings on top of multiple escarpments, and other points of interest. Suddenly I realized I'd neglected to add the actual known locations of *D. condor* gathered from herbarium specimens for its publication! Thanks to modern technology, from southern Ecuador I messaged my friend and *D. condor* co-author Paulo Gonella who quickly sent me the approximate latitudes and longitudes. To my delight, I realized that one of the locations was on top of an escarpment located a mere 400 vertical meters above the end point of the most promising of all roads, and only 2 km in a straight line from road to plateau! But the question was: would there be a trail to the top? The thick cloud forests of that region can make even 100 m an impossible trek.

It was only 3 pm when I arrived at a small village where that dirt road begins winding its way up to the Cordillera Del Condor. On a whim, I decided to make the best of the 2-3 hours of sunlight I had left and explore, never thinking I'd get very far. I was pretty sure I'd have to pay somebody the following morning to drive me up that road with a 4×4, but to my amazement, the dirt road was surprisingly good! So I kept driving higher and higher, navigating past several forks I'd previously marked on Google Maps.

Against all odds, an hour and a half later, having driven nearly 50 km and climbed >1000 vertical meters, I reached the end of the road with my puny rental car. I found a military outpost with two soldiers who were there on a 1-month rotation to guard the Ecuador-Peru border. Bored out of their minds with nothing to do up there, the topic quickly changed from "only military are allowed on the escarpment" to an eager "we'd love to climb up there with you", as I explained that I was a biologist craving to see native carnivorous plants. To my delight, they told me that there was indeed a trail to the top and that during their month-long rotation (which had just started the day before, on September 1st), it would be their job to hike up there to check on a border mark. Did I want to start now or early tomorrow morning?

Not believing my own good fortune, I drove back down the 50 km of windy mountain road, found a little hotel, bought food and drink for the following day, and went to bed early. I woke up at 5:30 am on Sunday and was back up the road at the military outpost a bit past 7 am, bringing my two new best friends some fresh produce and other food items as gifts. I was told there was no dry season in that area, that it was only wet and wetter season. The day before, I had barely glimpsed the Cordillera del Condor through the clouds and occasional rains. But Sunday morning was almost as good as I could wish for: sunny and only partially cloudy, which is how it stayed most of the day, with only occasional drizzle. It was truly my lucky day!

We started hiking at 8 am and after a mere 1.5-hour trek along a muddy but very broad trail (Fig. 2) climbing past mossy cloud forests (where I observed the epiphytic *U. jamesoniana* Oliv. and maybe *U. unifolia* Ruiz & Pav.), we arrived at a secondary plateau at ~2300 m altitude, below what I would quickly learn was the main plateau at ~2400 m (Fig. 3). I was in tepui heaven, it was exactly what I'd dreamed: low vegetation on wet sandy soil. It didn't take long for me to find the first *D. condor*. I never imagined it would've been that easy!

Figure 2: Starting the trek up the Cordillera del Condor from the Ecuadorian military outpost.

This first *D. condor* population was small, growing in a sandy/rocky island surrounded by a swamp – where surprisingly I didn't find a single *Utricularia* or *Genlisea*. Further promising habitats extended to the east, but I was intimidated from hiking in that direction due to signs warning of mine fields left over from the Cenepa War, a border conflict between Ecuador and Peru in 1995, stemming from previous border disagreements and clashes in 1981 and 1941.

Figure 3: View to the east from the second plateau of the Cordillera del Condor, standing at the large *Drosera condor* population.

Therefore, I had to walk past the tantalizing mine field and hiked with my two armed guides for another 15-20 min up to the main plateau, so they could "inspect" their border mark. At that point a group of 8 men caught up with us – they looked like traffic cops wearing fluorescent orange or yellow vests. They claimed to be employees of a local gold mining company and had climbed the mountains for "research purposes". On Google Earth I'd seen signs of mining nearby, as well as having driven past dozens of huge trucks on the dirt road going up and down those highlands. One of them told me they were "biologists" – but when I said I was also a biologist and tried asking what they were studying, I only got vague answers.

I didn't know whether to believe them or not, nor did I care much since I was too busy huffing and puffing my way up the last 100 m to the top, thus not the best time for a chat. Once I reached the apex, I took a few quick pictures at the border mark while catching my breath before heading into the Peruvian side to explore further. I never got to ask those guys any further questions because by the time I returned, they were all gone – including my two military guides. You see, I sort of got myself into a bit of a pickle…

It all started with a fantastic *D. condor* population just below the border mark (Fig. 3), growing at a seepage over a rocky area, as well as on sandy and peaty soil along the edges (more on this later). Looking further north and northeast, I could see a vast plateau. Immediately in front of me was an east-to-west valley polka-dotted with numerous open rocky areas that seemed to be calling to me, begging to be explored. In my mind, I saw rocky fields full of *D. condor*, and (considering my great luck that day) maybe I'd even be fortunate enough to also find the elusive *D. peruensis* which is known from highlands a mere 80 km south!

I had no second thoughts and soon headed downhill through what was initially dense but low vegetation. But the further down I trekked, the denser the vegetation became. Less than half an hour later I was bogged down to a snail's pace, using my arms more than my legs to wade past dense webs of vines hanging from short moss-covered trees. The floor became a tangle of roots and branches through which my feet would frequently slip, dangling above the true floor somewhere below. What a nightmare!

The further I trudged, the more difficult it became to turn back, psychologically speaking. A drone would've come in very handy, allowing me to see how close (or far) I was from the closest rocky area. A machete would've been better – but I have a bad history with those things… At last, I had to come to terms that I'd best turn back. Although it was still early in the day (noon-ish), the previous half hour had left me physically exhausted – and I was soon-to-be mentally exhausted too. My arms and legs ached terribly from the difficulty of wading through that thick vegetation. My sense of direction, usually pretty dependable, was thrown off by my physical botanical immersion within the vine-covered pygmy forest, which only allowed a narrow view of the sky above my head.

I was on a remote mountain, separated from my guides by not much more than a few hundred meters. But due to the wind and the fact that I'd been swallowed alive by the thick vegetation, they could scream my name at the top of their lungs without me ever being able to hear their voices – which I later learned is exactly what they did before heading back down the mountain, wondering if I'd ever return.

Fortunately for me though, I wasn't completely alone… Two local dogs had followed us all the way up from the military outpost and one of them had stuck by my side the whole time, stepping on every *D. condor* I tried to photograph, thinking I was about to feed or pet it. Surprisingly, it stuck by me even in the thickest vegetation, clambering skillfully over roots, between vines, and around large long-stemmed bromeliads. It started as a difficult relationship, with me having to physically lift the annoying dog multiple times to get him out of my pictures and off my precious sundews,

Figure 4: *Drosera condor* at ~2400 m altitude.

or holding him back with one hand while clicking pictures with my other hand. But when I finally surrendered and decided to start the exhausting trek back up the hillside to the border mark, our relationship slowly morphed. Disoriented and extremely fatigued, both physically and mentally, I was practically crawling through the green mesh that surrounded me. I had to stop and lay down multiple times to catch my breath and my bearings. Although my huffing and puffing only intensified the stench of that wet dog, it was nonetheless psychologically very comforting to have him there, my only companion in that vast and remote corner of the world. Soon I was petting him warmly and even sharing my food – while my weary mind considered whether he would eventually feed on my dead body…

Having wasted two valuable hours that I could have spent studying the local CPs (if only I'd made it to another rocky outcrop), I finally made it back up the valley to the border mark. Nobody was there. So, I spent some time catching my breath while studying the large *D. condor* population I'd found there earlier at ~2400 m altitude. My relationship with the smelly dog quickly soured again as it insisted on stepping all over the sundews I was trying to photograph.

I'm sorry to say that *D. condor* is a relatively scraggly and ugly sundew. Most plants had only 1-2 wine-red dewy leaves, sometimes none, surrounded by a rosette of black dead leaves (Fig. 4). It was hard to find nicer ones to photograph! There were lots of inflorescences in fruit, some still in flower, and a few young scapes still unfurling. Unfortunately, no flowers were open that day but the closed petals were a light pinkish in color.

I was hopeful that I would find some interesting terrestrial *Utricularia* on top of those remote tepuis, maybe a *Genlisea*, maybe even a new species of either genus. But alas, I only found a few darned *U. subulata* L. scapes. This was surprising, considering all the wet open spaces that looked perfect for species of both genera. I did see some flowerless *U. unifolia*(?) between the first and second plateaus that seemed to be growing terrestrially, but on closer inspection they were growing on dead logs.

As soon as I started heading down from the border mark, my dog companion finally got tired of me and dashed down the mountain. I was completely alone now, so worn out mentally and physically that I was barely paying attention to the cloud forests and epiphytic *Utricularia* flashing by me as I stumbled my way back down the muddy trail. My body was numb from fatigue, but my mind was on a warm and fuzzy sundew high that I've been fortunate to have experienced several times in my life. It's the kind of high a botanical nerd feels when he finally gets the opportunity to climb an amazing and faraway botanical paradise of a mountain that is home to a very very very rare and unique species he had been chasing down for over 20 years, that he ultimately got to observe in the wild for the first time, and which only a few people have ever seen alive before – which describes my relationship with this ugly and scraggly (but adorable) sundew that is *D. condor*.

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Hunting and killing plants for science

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Introduction

Carnivorous plants provide many possibilities for research—for examples, we can investigate issues like the details of their evolution, how they migrated across the continents, and what their futures may look like in the context of our changing climate. The primary data to fuel these speculations is a solid knowledge of the current distributions of carnivorous plants. So, it is important to discover as many of their populations as possible, and to check in on them time to time to monitor their health. This is not an easy task, as the plants are often found in obscure, difficult to reach locations.

As a scientist, my primary interest is in assessing the current distributions of carnivorous plants in the western states of the USA. I enjoy working with old, sketchy, or otherwise incomplete information, and by combining those leads with modern resources and my own expertise, I am often able to track down previously detected carnivorous plant sites, and also find new, undocumented locations.

Preparatory Work

Carnivorous plant enthusiasts often read field trip reports by plant explorers, such as myself, and wonder how we figure out where carnivorous plants might live. Let me be clear about this—it is not easy, and it takes a tremendous amount of work—much of it is done before we even head outdoors!

I learn of possible sites from many sources. Biologist friends might tell me about something they saw during their own fieldwork. I might find site information on internet compendia of images or biological assessments. Old books, papers, and herbarium specimens may include passing references to potential sites. All these things can alert me to the possible presence of a place worthy of investigation.

Once I have a lead for a plant site, the next step involves trying to narrow down the likely locations, as much as I can. (I couldn't even begin to count the number of times I've looked for places referred to only as "Grass Lake" or "Lily pad marsh.") Mapping tools such as Google Earth are enormously helpful in examining aerial imagery. Combining those tools with topographic maps and reference works listing place names can often narrow down likely options even more. Eventually, I usually identify a cluster of sites that must be investigated.

Now for planning the trip… I carefully gather GPS points for each site I want to visit, and then study maps to try to develop several approaches, each of which gets me as close as possible to the target points. The reason I plan multiple routes is that, while one road may look great from aerial maps, it may be in fact impassable. It might enter private property and be posted against trespassing. Storms, earthquakes, or fires might have resulted in mudslides, rockslides, or washouts. Downed trees might block my passage. The list is nearly endless—once while botanizing on tribal lands in Arizona, many roads were closed to non-tribal visitors because of sacred events. Another time, a friend of mine, driving on a public road in a remote area in California notorious for *Cannabis* plan-

tations, was stopped by heavily armed, sketchy civilians who told her that the road was private, and she had better turn around. She did.

Also—and this is a step that cannot be skipped—it is critical to determine who or what agency has ownership or management of the land. I am amazed when people don't seem to understand that every square meter of the USA is owned or managed by someone. You have to contact the appropriate people involved, and be ready to deal with possibly being told that access is simply not allowed, or otherwise restricted.

Once all this is done, I can finally put gas into the car.

Hitting the Road

The first attempt to visit a site is often just a reconnaissance trip in which I try to get as close to a site as I can. Sometimes I'll do these trips in late winter, when the site might still be under snow (if it is at high elevation), but at least I can see if the approach is possible. If I am hugely lucky, I might be able to drive right up to the site on my first visit, although this is rare. More typically, I might be able to get to within a few km of my target destination. Trails to target locations are rare, so I usually have to bushwhack the final approach.

For those unfamiliar with bushwhacking, it is vastly different from trail hiking. It can be extremely time consuming and exhausting. If your path takes you into a forest blowdown (where fallen trees lay on top of each other like matchsticks), or dense forest, or mucky swamp, every step can be an effort. In such situations a GPS alone becomes useless because it is so easy to get turned around. A compass is critical—and make sure it is not one that depends upon a battery! Sometimes the route, which seemed so trivial at home on Google Earth, turns out to be impossible. All you need is a sheer cliff only 3 meters tall, or a stream roaring with spring snow melt, or an illegal *Cannabis* plantation, to be turned back. What looked like a grassy field in aerial photographs may turn out to be flooded, muck-filled wetlands.

Add to this the fact that you are in a wildlife situation—you must keep your eyes open for any number of hazards along the way, such as surprised animals, plants with lacerating surfaces, and dangerous footing. Once, on a narrow path navigating the walls of a cliff in Montana I found my way blocked by a stubborn mountain goat—unwilling to be knocked off the cliff to my death, I had to turn back—even though I had hiked more than 12 km to reach that point! The most dangerous hazard of all is other humans that might have their own agenda that might not fall within the realms of legality.

Sometimes, sites are simply unreachable with the time and resources you might have. A few years ago, I was planning a visit to a mountain site, just to find that my desired site was in a wilderness area that would take at least a few days backpacking each way to reach—and all within active grizzly bear territory. Not my cup of tea…

Arrival!

Reaching a destination for the first time is always exciting. If the site is small, it may not take much time at all to either locate the plants, or to determine that habitat degradation has resulted in the death of all the carnivorous plants that might have once been present. On the other hand, if the potential site is large, it might take hours (or even multiple trips) to scour the entire area to find plants. For example, I surveyed a site in Idaho—a wetland valley about 1 km × 1 km, with a complicated matrix of ponds, waterflows, and small forested patches—and it took several hours of

crisscrossing over difficult terrain before I finally found a very small microsite supporting populations of *Drosera anglica* and *Utricularia minor*.

If I detect plants, and I have appropriate permission (or permits) to collect plants, I start counting... I follow a 1-in-20 collection rule, meaning that I will only collect a specimen if there are at least 20 plants present. Usually, this is not a limitation, as carnivorous plants typically grow in large numbers, but on occasion this is an important consideration. Sometimes I will collect more plants than I need for my own herbarium, if I intend to give specimens to another institution. I do this especially if I want to thank an organization or agency that gave me permission to work at the site, or that provided information that was useful to me in locating the site.

When I collect plants, I make sure the specimens are typical of the population—I do not collect the largest plant, or the smallest, or clumpiest, or whatever. I select typical specimens—if possible with flowers, etc. I carefully wash soil from the roots or stems and place the specimen carefully in the carrying container I have with me. I also record appropriate data such as GPS coordinates, and photograph any other plants that might have caught my interest. Those who are familiar with my presence on social media know that sometimes I will capture some video for later posting on line. I hope that the video I produce may contribute to the public understanding of how our wild lands are valuable in a natural state and are not just resources to be exploited and destroyed.

Pressing and Preparing the Specimens

A critical tool for field botanists is a field press (Fig. 1). Usually, I keep my press in the car—it is too massive and bulky to take on the trail. Furthermore, it is usually filled with specimens from earlier in the season that I do not want to damage.

Back at the car, I place my specimens in the press. Collections are arranged between sheets of newspaper, which are then sandwiched between sheets of blotter paper—and as appropriate—sheets of cardboard. Each specimen is also accompanied by a slip of paper recording data such as species name, collection date, location, etc. The press is closed, then squeezed tightly and the specimen is allowed to dry. In my arid conditions, this is not difficult, but when I am botanizing in humid environments mold can be a problem if you aren't careful. Particularly wet collections, such as *Utricularia*, should be towel dried before being placed in the press. I have discovered that collections of sticky or mucilaginous plants like *Drosera* and *Utricularia* should be accessed after a day and moved to fresh newspaper—otherwise they often become permanently attached to the newspaper. Ultimately, the specimens usually stay in my press for several months.

Figure 1: An exploded view of an herbarium press. At left. the wooden frame, straps, and cardboard dividers; bottom right, newspapers; top right, blotter paper.

Many months later, usually during the winter when my field season is mostly over, I pull the specimens out of the press and prepare them for preservation (Fig. 2). This re-

Figure 2: Gluing completely dried specimens onto herbarium paper.

Figure 3: *Drosera* specimens weighed down with coins, as the mounting glue sets.

quires special materials. The sheets of paper that the specimens will be mounted on are acid-free, and of archival quality. The adhesive is water-soluble, archival glue. Even the labels I use to annotate the specimens are acid-free.

The specimens are arranged on the sheets in a way that displays the plant's characteristics—for example, both sides of the leaves, as appropriate. I also like to place the plants in a way that evokes the way the plants grow in the wild—if it is a *Utricularia* with horizontal green shoots and descending bladder-bearing stolons, I mount them accordingly. There is a certain beauty to properly presented specimens.

Gluing the plants is a tedious process but must be done carefully. I use coins to weigh them down as the glue dries (Fig. 3). Finally, I add a label that includes information about the collection—plant name, geographic data, collection date, collector's name and collection number, etc. (Fig. 4)

Voila!

I am occasionally asked by hobbyists why I do not collect plants for live collections. I do not because I almost never see plants that have truly notable characteristics, and most of the plants I am collecting are already well-established in collections. Furthermore, the undeniable antagonistic relationship between horticulturists and land managers—while much improved when compared to years past—still complicates the good will I require from agency staff, in order to conduct my research. The very few times I have found plants of horticultural interest (for example, *Darlingtonia californica* f. *viridiflora*), I have tried to work with the appropriate authorities to introduce the plants into horticultural circles.

Figure 4: Finished, annotated herbarium specimens.

Storage

I hold a researcher position at the University of California (Davis) Center for Plant Diversity, so that is where I store the bulk of my collections. Occasionally, as noted above, I will collect for other institutions as well. The Center for Plant Diversity has a fantastic herbarium, where the specimens are stored in cabinets in refrigerated conditions (Fig. 5). When I submit specimens to the herbarium, they are first frozen for several days to kill any insects that might spend the decades feasting upon invaluable herbarium specimens. Once in the herbarium, the specimens are kept in clean rooms, and if they are ever loaned out to other institutions, they are refrozen before being stored back in the collection.

It is always humbling to look at my specimens in herbaria. The plants I have collected will far outlive me—they are the scientific legacy I will leave behind. Indeed, I have used herbarium speci-

Figure 5: Herbarium cabinets on wheels (left). These can be moved back and forth to access the collections they contain (right).

mens many decades old, and in the same way I hope that my research can aid those who follow. I know that many of the sites I visit will not support carnivorous plants in the future, but at least this way future researchers will have irrefutable evidence that plants were there, in the past. My specimens are time travelers.

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My experiences over-winter with *Pinguicula planifolia*

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It's hard to believe that I have been exploring the Gulf Coast region now since 1971. I have to wonder how many thousands of miles I must have traveled in those 47 years. Sadly, most of the sites I visited during that time are now gone. Some were massive, multi-hectare locations supporting many thousands of carnivorous plants, while others were small, specialized habitats with only a limited number of plants. All were precious and their loss is both heartbreaking and nothing short of criminal.

While I must admit that the showy *Sarracenia* attracted most of my attention thanks to their wide diversity of forms and extravagant coloration, most recently I have been devoting a lot of time to studying our native *Pinguicula* species. There are many sites with large populations of *P. planifolia* within about an hour's drive from my home in Tallahassee, particularly in the Apalachicola Forest where it grows in a wide variety of environments from open grassy savannahs to shallow ponds, where it attains its largest size (Fig. 1 & Front Cover). In the summer, some specimens grow wider than the palm of my outstretched hand, which puts them at or even over 23 cm, though the majority are in the 18-cm range.

Although *Pinguicula ionantha* also grows here, it is far less tolerant of our recent increase in drought conditions, often vanishing for an entire year or more, then reappearing again in impressive numbers following periods of above average rainfall. Because not all specimens of *P. planifolia* attain their characteristic deep red coloration, it can sometimes be difficult to differentiate between the two species when they are growing together unless they are in flower. Keen observers will note

Figure 1: *Pinguicula planifolia* growing in a pond in the Apalachicola Forest.

Figure 2: *Pinguicula planifolia* growing submerged in a pond.

that in pond sites, *P. ionantha* is more numerous in slightly deeper water, even if only by a matter of a cm or so. When rainfall comes to a sudden stop and sites begin to dry up, that tiny bit of extra depth can mean the difference between continued survival and certain death.

Lately I have been growing *P. planifolia* as an aquatic (Fig. 2). Like most people, I originally grew the plant like I grew my *Sarracenia*, in the greenhouse in pots of moss or a sand/peat mix sitting in trays of water. They did well enough, usually flowering in the spring, but certainly never attaining anything like the size I would encounter in the field. As many of my *Sarracenia* seedlings gradually grew to the point where they required individual pots, I moved some *P. planifolia* out to make room. Eventually I unpotted the dozen or so plants I had and transferred them into a small tub, then moved the tub outside during the next phase of my pitcher plant expansion.

It was at this point that the tub began to fill up with rainwater from our afternoon thunderstorms. If I noticed there was too much water, I'd dump some out, but over time I noticed several things: The plants were now flowering far more freely over a longer period of time and setting a good amount of seed, but they were also attaining a larger size. I typically add a small amount of distilled white vinegar to the rainwater that I use (about 15 ml per liter of water) to maintain the acidity levels almost all CP prefer. This quickly caused the *P. planifolia* to attain a deeper, richer color. Note: I recommend growers purchase an inexpensive pool water test kit to assure your water is truly acidic.

The seeds of *P. planifolia* are quite fertile when fresh, and eventually I had so many plants that I had to dedicate a second tub to them. I also discovered that like most Mexican *Pinguicula*, our native *P. planifolia* were capable of producing plantlets or pups from leaves that were very carefully removed from the mother plant and dipped in a rooting hormone (at the time I was using Rootone®).

About 18 months ago, while choosing *P. planifolia* specimens to send to others, I placed them temporarily — or so I thought — in a smaller tub that contained no growing medium at all: No *Sphagnum*, no sand, no peat, just rainwater. I should note here that, over the years, experience taught me to remove all vestiges of soil from around the roots of any native *Pinguicula* I was going to

mail. Then, as so often happens, life threw me a curve ball and I ended up getting injured at work and was out for five months due to head trauma and concussion. Fortunately, at the time we were having fairly regular rain showers, so I was not particularly concerned about any of my plants.

When at last I had recovered, I noticed the plants I had set aside were flourishing. Yes, some debris had found its' way into the tub (mostly pine needles and a few other leaves), but after about a month, the plants in the water were even larger and more colorful than those in either of the other two containers. I decided to split my collection of *P. planifolia* into two tubs: One group with standard soil medium and the other in water only. I should note here that I never completely submerge the plants; there always remains some leaf surfaces that are above the water line and these continue to catch whatever prey may be present.

Figure 3: *Pinguicula planifolia* frozen in a block of ice.

You probably won't be surprised at this point when I say the plants growing semi-aquatically (or sometimes completely aquatically during periods of heavy rain, such as we had last summer) continued to look better than those grown in sphagnum or a sand/peat mix.

Now comes the really mind-blowing part: Last October started off hotter than normal, but the weather quickly turned cold. I decided to just leave the outdoor *P. planifolia* where they were. Within a month or so we began a period of bitterly cold weather. Around Christmas, I checked the *P. planifolia* and found they were quite literally frozen solid. I tipped the tub on its side and the plants came out encased in a block of ice, yet the plants within appeared to be in near-pristine condition (Fig. 3). While I knew *P. planifolia* must experience hard freezes in the field, I thought they would sustain some damage, then quickly recover once warmer weather returned. But these plants showed no signs at all of any sort of stress.

Lately, quite a few growers have expressed interest in our native *Pinguicula*, but many indicated they had previously lost their plants over winter. Others told me they were simply not able to provide the milder temperate conditions they believed the plants required. Yet I now have proof positive that the plants can handle much colder conditions than any of us ever imagined, as our nighttime lows during December and January ranged from about -8°C to -4°C for a number of weeks. I am now convinced these plants prefer — maybe even require — a period of cold weather. My plants are all either flowering or putting up buds, yet two weeks ago they were still freezing solid at night!

Because we love our plants, we tend to grow them conservatively. Nobody wants to lose a plant if we can help it, but in some cases, we are basing decisions on outdated or even misleading information. Just because most people have grown a particular plant a certain way does not mean it is the *only way*, and I have learned first-hand that *P. planifolia* is much tougher and far more adaptable than we ever believed.

I've always been in awe of the fact that this plant can grow in water that is surprisingly hot during the summer. To discover that it appears to be tolerant of both temperature extremes is a revelation. It makes me wonder what other secrets these amazing plants have yet to reveal to us.

On the cultivation of *Drosera magnifica* Rivadavia & Gonella, the Facebook Sundew

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To be afforded the opportunity to cultivate a new species is something one should always regard as a privilege. To have the chance to grow a species such as *Drosera magnifica* goes beyond this, and I have been one of the fortunate few who have been gifted with the material to attempt cultivation.

This unique species, the largest in Latin America, was 'discovered' by Paulo Gonella in 2013, amongst a collection of field photographs taken by amateur botanist Reginaldo Vasconcelos. The images had sat online for some time before this incredible species of *Drosera* was noticed. Vasconcelos had been exploring the Pico do Padre Angelo, in eastern Minas Gerais, Brazil, and posted his findings on Facebook. Here it was found in a vegetation type known as *campos rupestres*, Portuguese for *rocky fields*, an area characterised by montane shrubby vegetation at an elevation of between 700 to 2000 m. Gonella subsequently visited the location, and the species was formally described in 2015 (Gonella *et al.* 2015).

Drosera magnifica is found at an approximate elevation of 1500 m, an interesting observation when one considers its cultivation, as this tells us that the species appreciates the coolness that this elevation affords. It is found growing in well-drained organic matter and sand over sandstone, and in the company of orchids, bromeliads, and *Vellozia* (Fig. 1). It is the largest *Drosera* species in the Americas and forms a woody stem to 120 cm, which scrambles through the surrounding vegetation, topped by a rosette of erect/semi-erect filiform leaves to 24 cm in length. More details of its discovery and a detailed description can be found in Gonella *et al.* (2015), Gonella (2016), and Robinson *et al.* (2017).

Figure 1: Adult *Drosera magnifica* in habitat. Photo by Paulo Gonella.

Bearing in mind the habitat information, it was assumed that the cultivation of this species would follow that of other South American species from similar habitats and elevations, and hence, it appears to enjoy conditions similar to *Drosera spiralis*, along with *D. graminifolia*, with which it is closely allied.

Seeds were sown on a mix of equal parts quartz sand and peat and kept in a terrarium with a daytime temperature of 22°C and a nighttime temperature of 15°C. They received a photoperiod of 16 hours.

In these conditions, germination took between four and six weeks, and other growers have reported germination in a similar timescale and even less for *in-vitro* germination, an aspect I shall leave to another to write about (see articles by Hausherr and by Reimansteiner, this issue).

Figure 2: Seedlings kept in terrarium conditions remain small. These are ca. 12 months old.

Interestingly, I sowed a few seeds in greenhouse conditions, and none germinated. Moving the pot subsequently into the terrarium, and the higher humidity, prompted them to germinate and grow. The plants remained small, and indeed, a pot which remains in the terrarium as a backup, are still at the seedling stage one year after sowing (Fig. 2).

I removed a number of the young plants from the terrarium in the autumn, once the risk of high temperatures had passed, and potted them individually into 5 cm pots in the same mix as above and placed them in greenhouse conditions. These plants have continued to grow over the winter months, with a minimum temperature of 10°C, and with LED lights as a supplement (Fig. 3).

Figure 3: A juvenile *Drosera magnifica*, ca. 12 months from germination.

Bearing in mind the winter in habitat is cool and drier, I kept them damp, rather than wet, and they have continued to grow, albeit slowly, with the largest now at approximately 12 mm in height. The application of a half strength dose of fertiliser (Orchid Focus Grow (20:10:20)), every two weeks seems to have benefitted the plants over the winter months, as did the application of dried fragments of bloodworm, though this does carry the risk of rotting the leaves in grey damp conditions, so is best carried out in the spring and summer months. I rather suspect this is a species that if fed well, will grow well; this has certainly been proven so far.

To re-cap, and emphasise my greenhouse conditions, the plants will move to larger containers of the same mix, sit in shallow water for the summer, and not overheat. For the winter, they seem to appreciate a drier mix, and remain just damp. In short, the same conditions as *D. spiralis* and *D. graminifolia*, which in my experience can also rot if kept too wet over the winter months. As the plants grow, I imagine they'll like a deep pot for their roots, this in itself aiding to keep the right amount of moisture present for the plants at this critical time.

I've heard this plant's culture is compared to that of *D. regia*. This draws important parallels, as that species is more readily grown by hobbyists, and therefore sends out the valuable signal that if you can succeed with *D. regia*, you can succeed with *D. magnifica*. From what I've seen so far, and remember, these are the embryonic days of cultivation of this unique species, that is exactly what I'm finding.

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Propagation of *Drosera magnifica* Rivadavia & Gonella *in vitro*

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Most species of *Drosera* sect. *Brasiliae* comprise easy-to-propagate taxa *in vitro* with a high rate of multiplication on media without cytokinines (Fig. 1). However, *Drosera magnifica* Rivadavia & Gonella differs from other species in this section in the lack of shoot production of young plants on "plain media". Therefore, plant hormones are vital to clone a substantial amount of genetically different plants in a short amount of time and help to establish it as quickly as possible in cultivation.

Figure 1: *Drosera villosa* A.St.-Hill. - a species with a high self-multiplication within *Drosera* sect. *Brasiliae*.

Seeds of *D. magnifica* were surface-sterilized in a solution containing 25% of the original Murashige & Skoog salt and vitamin-mixture, 4% PPM™ (Plant Preservative Mixture), and 1.6 ml l^{-1} Polysorbate 20 as a wetting agent. Three different soaking durations were tried lasting 6, 8, and 10 hours, respectively.

The *in vitro* medium (No. 1) consisted of 30% of Murashige & Skoog-medium including vitamins, 25 g l^{-1} sucrose, and 2.75 g l^{-1} Gelzan™. The initial pH of the medium (5.7) prior to autoclaving was adjusted by 0.5 M KOH and HCl.

Each seed was transferred aseptically – without rinsing in sterilized, deionized water – on ca. 7.5 ml of medium in gamma-sterile 50 ml Falcon™ centrifuge-tubes. The racks of tubes were then placed under white fluorescent lights (25 µmol m^{-2} s^{-1} PAR) at a light/dark-regime of 15/9 hours and a temperature of 22±1°C.

Figure 2: Six different clones of *Drosera magnifica* growing inside the Microbox™ vessel.

First germination occurred after 24 days with an average germination time of 32 days. In total ca. 67% (n=24) of the sowed seeds germinated. The best results were achieved when sterilizing the seeds for 6 hours, whereas germination consistently decreased with longer sterilization times. It is further recommended for *Drosera* to use a pH ranging from 5.7 to 5.8 or a buffer (e.g. MES monohydrate), as the plants accumulate H^+, which results in a more acidic medium.

After 174 days the plants were transferred to 80 ml of medium (No. 1) into vented Microbox™ - vessels (Fig. 2, red HEPA-filter), which allows a constant gas exchange. The individual clones were not multiplied so far, however, will be replated soon on new media (No. 1) supplemented with 0.4 mg l^{-1} 6-BAP for shoot induction. As *D. magnifica* generously produces roots *in vitro*, there will not be the need of using auxins before hardening off *in vivo*.

In vitro culture of *Drosera magnifica*

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Seeds of *Drosera magnifica* were placed in filter paper and sterilized in a solution containing NaDCC (sodium dichloroisocyanurate) in concentrations of 500 and 700 ppm. In addition to a few drops of polysorbate 20 which acts as a wetting agent supplemented by 35 g l^{-1} sucrose in order to receive an isotonic sterilization solution.

After a period of 24 hours with periodically shaking of the containers, seeds were transferred to an aseptic environment and rinsed once in previously sterilized water. The freshly sterilized seeds were placed on 1/3 Murashige Skoog medium supplied with 25 g l^{-1} sucrose and 2.75 g l^{-1} gellan powder. The initial pH was set to 5.6 by using HCL and NaOH.

The vessels were placed under lights with a photoperiod of 16/8 hours and daytime temperatures of ±23°C with nighttime temperatures of about ±19°C. The first signs of germination occurred 24 days after establishing shown with certainty on day 30. Overall, I could not observe any drastic changes in the germination rate of the two different concentrations.

With their first replate, the plants were transferred to a 1/3 Murashige Skoog media containing PVP (polyvinylpyrrolidone) at a concentration of 0.5 g l^{-1} in order to help absorb possible phenolic exudates of the plantlets.

It seems like *Drosera magnifica* does not multiply on its own as you would typically expect from observations of other species of this genus under sterile conditions. The next step would be to place explants onto cytokinin enriched media to start multiplying this species.

Drosera magnifica cultures 104 days after first germination. (Scale in mm).

Several specimens displayed on a petri dish 132 days after first germination (diameter 15 cm).

In conclusion, I observed this species as steady growing under sterile conditions. The next steps for me will be to multiply each specimen and start to acclimate the first plants to determine their viability and growth under *ex vitro* conditions.

Keywords: cultivar, *Dionaea muscipula* 'Sensor', *Cephalotus* 'Elizabeth', *Sarracenia* 'Ellie Wang', *Sarracenia* 'Flavona'.

Dionaea muscipula 'Sensor'

Submitted: 1 May 2018

In September 2013, I first noticed that this plant had unique characteristics compared to other *Dionaea muscipula*: the teeth of the traps merged in variable groups (Fig 1a) and there were always six to nine sensory trigger hairs within the trap on each side (Fig 1b). This characteristic has been persistent and is more accentuated during the spring/summer vegetative period. Each trigger hair proved to be functional and useful for closing the trap.

Dionaea 'Sensor' differs from *Dionaea* 'Carniplant' in that *Dionaea* 'Sensor' never is bright red and usually attains only a peach color, the teeth remain almost white, and it maintains 12 to 15 trigger hairs per trap.

Growth has always been particularly vigorous, producing many leaves and new rhizome divisions each year. The plant remains mostly prostrate and reaches a good diameter. The color inside traps is sometimes remains green despite bright sunlight. These characteristics have been stable and persistent since 2013.

The perfect name that immediately came to mind on 24 August 2014 for this cultivar was "Sensor", because of the high number of trigger hairs and for the sensory capacity that each trigger hair has to close the trap.

Dionaea muscipula 'Sensor' must be reproduced vegetatively to preserve the characteristics of the cultivar.

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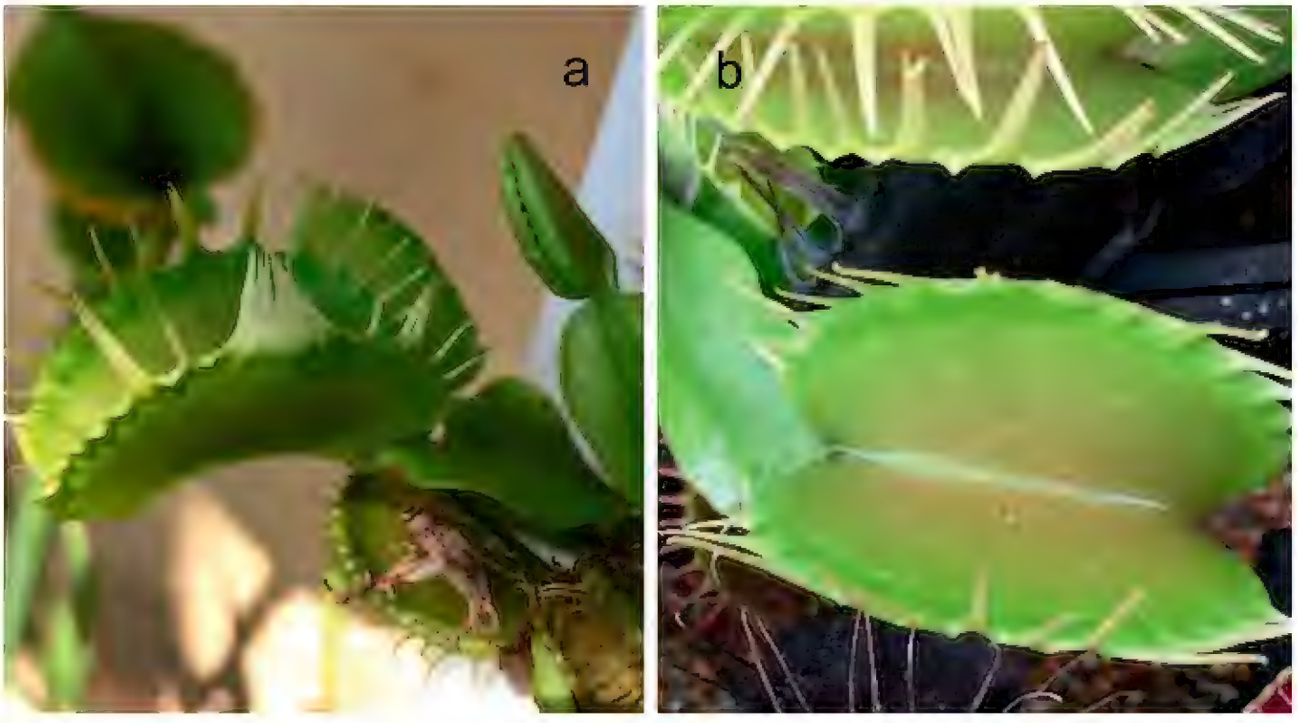

Figure 1: *Dionaea muscipula* 'Sensor' merged teeth (a) and numerous white trigger hairs (b).

Cephalotus 'Elizabeth'

Submitted: 31 May 2018

Cephalotus 'Elizabeth' has absolutely been a true joy for me to grow since I received it in December of 2011. It was originally selected for its overly defined peristome, as well as for being rather hairy. However, after sharing the plant with other carnivorous plant hobbyists here in Oregon, an even more captivating feature was brought to my attention. Instead of having the normal lid of a typical *Cephalotus* pitcher which curves downward towards the peristome, the lid of *C.* 'Elizabeth' stands completely upright (Fig. 2). In doing so, the lid flattens out and slightly splits to a notch in the middle to accommodate for the stretch. The average adult pitcher size is about 5 cm excluding the added height of the lid. Including the lid, adult pitchers reach 7 cm. In strong lighting, *C.* 'Elizabeth' produces alluring, dark pitchers. It does not produce many non-carnivorous leaves in my experience, however *C.* 'Elizabeth' is propagated just as easily by pitcher pullings.

After many years of quietly propagating *C.* 'Elizabeth', I've come to appreciate the unique characteristics it holds true to and am very excited to finally share it with the community. It regularly commands a closer look from hobbyists and newcomers alike. For me, *C.* 'Elizabeth' happily grows under a set of T5 HO lights 12-15 hours a day with an average temperature of between 21-24°C. Reproduction of *C.* 'Elizabeth' must be vegetative to maintain its specific traits.

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Figure 2: *Cephalotus* 'Elizabeth'.

Sarracenia 'Ellie Wang'

Submitted: 31 May 2018

Sarracenia 'Ellie Wang' is a very complex man-made hybrid, the details of the cross remain a trade secret. This spectacular and stand out bi-colored individual has a bright white lid with a solid, bright raspberry-red body (Fig. 3). The sharp contrast between the two colors make this plant stick out of the crowd! The top of the lid contains a network of stunning red veins. The entire interior of the oval-shaped mouth, including the neck of the trap, has subtle dark veins with a solid raspberry-red background. The neck of the trap, relative to the mouth and lid, is somewhat thin. Outdoors in Northern California, the plant consistently colors up very easily and does not require an "artificial suntan" or greenhouse cultivation to reach its fullest color potential.

One great feature of this cultivar is the growth habit: under optimal conditions, each growth point can produce multiple pitchers throughout the grow season. The traps color up immediately upon opening, but reach their peak, deepest color potential about 2 weeks after opening. *Sarracenia* 'Ellie Wang' is a vigorous and easy to grow cultivar.

Under my conditions, the traps have reached a maximum of 61 cm in height in a 15.24 cm pot, although I suspect this cultivar may be able to produce slightly taller pitchers if given a bigger pot.

The flowers have red petals, red sepals, and red tepals. Overall, it's nearly indistinguishable from a typical *Sarracenia leucophylla* flower.

Sarracenia 'Ellie Wang' must be produced by vegetative means to maintain the unique color features and growth habit.

This cultivar is named after my daughter, Ellie Wang, who is named after Eleanor Roosevelt. During World War II, Eleanor Roosevelt sent ships overseas to help save people fleeing from the Nazi invasion, which saved the lives of my Russian grandparents and gave them an opportunity to relocate to São Paulo, Brazil. Had she not sent those ships, I would not likely be writing this cultivar description today!

Figure 3: *Sarracenia* 'Ellie Wang'.

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Sarracenia 'Flavona'

Submitted: 31 May 2018

I have been cultivating this *Sarracenia* since August 1996, after receiving a small division of rhizome from a gardener of the Botanical Garden of Geneva (Switzerland), as a gift. I was visiting the garden when I was amazed at the greatness of that plant growing in a greenhouse. A kind and generous curator, seeing me so fascinated and impressed, he detached a piece of the great rhizome and gave it to me.

So, I have the pleasure and the honor of cultivating this specimen for 22 years, I grew it with great success and the plant has always been very vigorous in its development. I have divided it many times and it is widely spread among the various growers and enthusiasts in Italy and Europe.

The plant is also informally named as "F199 Mike King", my friend and sublime English grower, known all over the world. Mike received a division from me in 2004.

Its morphological and chromatic characteristics are typical of the species *Sarracenia flava*, probably a hybrid between *S. flava* var. *ornata* and *S. flava* var. *rugelii*, or a back-cross, but I cannot tell if it is natural or man-made because I do not know its story before 1996.

The major traps grow between the end of March and mid-May, just after the buds have sprouted. The typical "phyllodia" grow during the warmer season. Towards the middle and the end of the summer new traps develop, smaller than in spring and with more veins on the neck and under the lid.

The throat is strongly stained red, while under the lid dark red veins are drawn that appear more finely also on the body of the pitcher tube, more towards the top, light green in spring to become pale yellow in full summer, under strong light conditions (Fig. 4). The flowers are typical of the species *Sarracenia flava*, yellow, with stems between 60 and 70 cm high.

Figure 4: A 93-cm tall *Sarracenia* 'Flavona' pitcher (left) and over 50 pitchers growing in an 80-cm diameter bowl (right).

For three years, I have been cultivating it in a round bowl, 25 cm deep and with a diameter of 80 cm, which now completely fills with a single, individual rhizome that has many and indefinable growth points.

It has always had, over the years with me, an imposing size, with average heights of the larger pitchers between 70 and 80 cm, with peristome diameters between 9 and 12 cm. Remarkable!

This year, however, it is truly impressive: its overall size and proportions are beyond expectations and every other vintage!

Here's the surprise: in the spring of 2018, the plant developed 50 to 60 pitchers, many of which are over 80 cm tall, the highest developed up to 92-93 cm (Fig. 4) and 11-12 cm wide!! Incredible and wonderful! Powerful! A colossus!

The pitcher lids, measured from above, reach up to 14-15 cm in diameter! Almost as wide as an open hand. I understood from the first sprouts in April that they would be big traps, as the bases of some are almost 1 cm. A pure show!

This fantastic and perfect proportion between the width of the entrance and the height of the whole trap is the real secret of the fatal attraction of this specimen, a true plant monster, a vegetable giant of great magnetism and charm.

Personally, despite 35 years of cultivation, having seen and cultivated many *Sarracenia* and visited various collections, I cannot remember a plant so capable of striking at the heart of every fan of the genus every time he/she manages to meet closely. For this reason, I decided to officially register it, in order to pay homage and name this unique cultivar of *Sarracenia flava*.

I repeat, growing it in my greenhouse for 22 years is a pleasure and an honor for me, still grateful to the Botanical Garden of Geneva for the gift of many years ago and also grateful to *S.* 'Flavona' for the amazement it was able to give me in these years.

Naturally, the epithet "Flavona" is the Italian superlative of "flava", in order to describe the gigantism of its proportions in one word.

To be sure of keeping the characteristics unaltered, multiplication is carried out by division of the rhizome.

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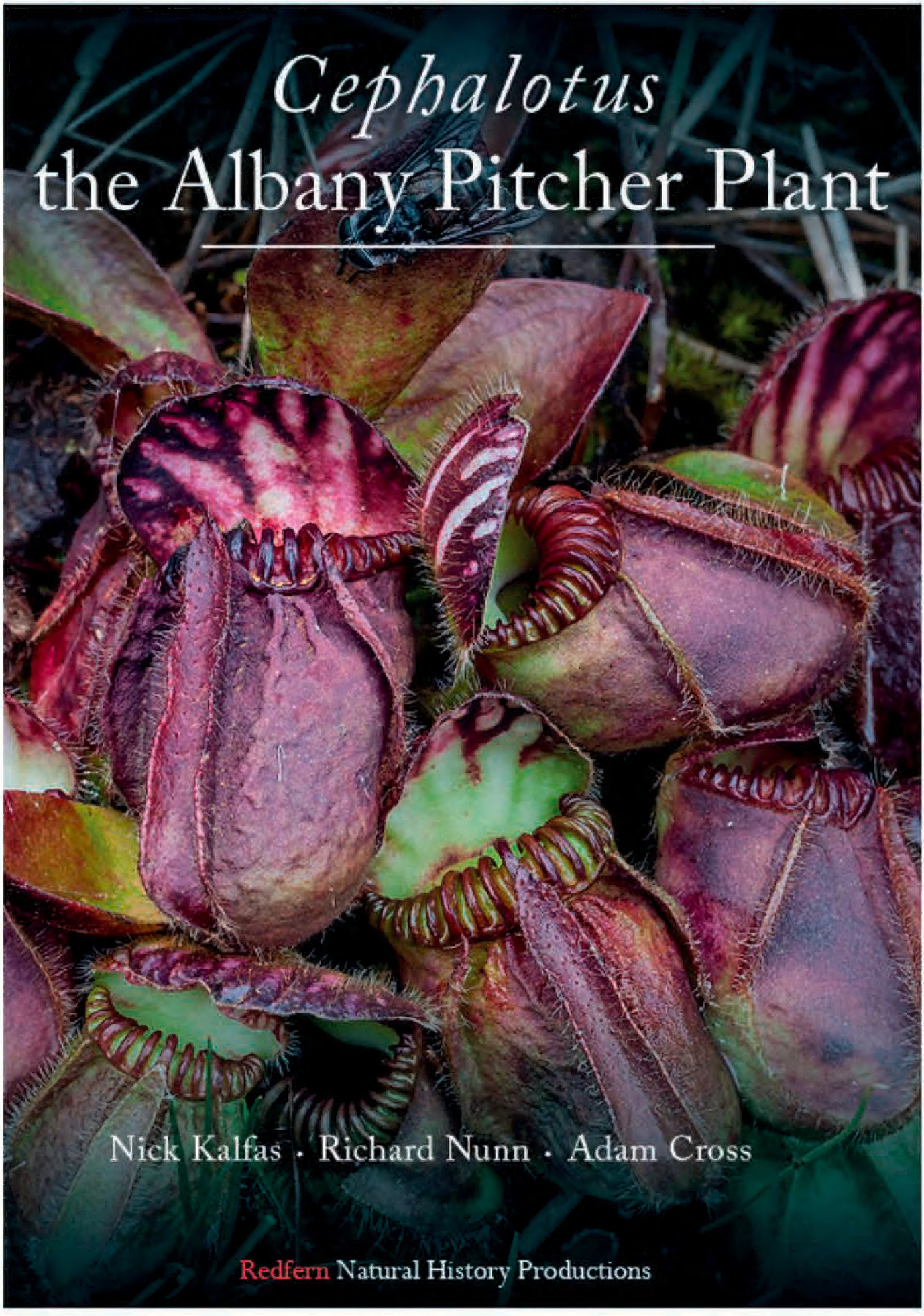
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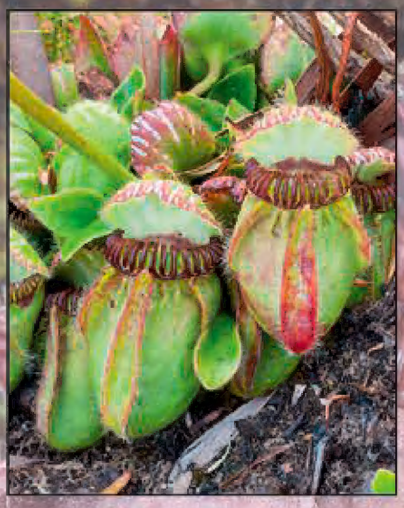

"*Cephalotus*—the Albany Pitcher Plant" is the first monograph of the monotypic *Cephalotus follicularis,* a species that is instantly recognisable for its distinctive and charismatic insect-trapping leaves. This generously illustrated volume features original botanical art and photographs, documenting this remarkable Australian endemic in unprecedented detail, with the most up to date summary of its status in the wild along with new genetic analyses of the majority of known populations.

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